PTO 06-302

Japanese Kokai Patent Application
No. P2000-96097A

# AQUEOUS LIQUID DETERGENT

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UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. OCTOBER 2005
TRANSLATED BY THE RALPH MCELROY TRANSLATION COMPANY

JAPANESE PATENT OFFICE
PATENT JOURNAL (A)
KOKAI PATENT APPLICATION NO. P2000-96097A

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| Int. Cl.[7]: | C 11 D 17/08<br>10/02<br>//(C 11 D 10/02<br>1:72<br>1:04<br>C 11 D 3:04<br>3:20<br>3:37) |
| Filing No.: | Hei 10[1998]-268332 |
| Filing Date: | October 22, 1998 |
| Publication Date: | April 4, 2000 |
| No. of Claims: | 6 (Total of 6 pages; OL) |
| Examination Request: | Filed |

# AQUEOUS LIQUID DETERGENT

[Suise ekitai senjyouzai]

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[Attached amendments have been incorporated into the text of the translation.]

* * *

Claims

1. An aqueous liquid detergent, for which a 1 wt% aqueous solution (25°C) has a pH of 10 or higher, comprising

(a) 0.5-50 wt% of an alkali agent;

(b) 0.1-25 wt% of a low-foaming nonionic surfactant;

(c) 0.1-30 wt% (fatty acid amount) of a fatty acid represented by general formula (I) or a salt thereof:

$$R\text{-}COOH \qquad (I)$$

(in the formula, R denotes a linear aliphatic hydrocarbon group with a carbon number of 3-13 or a branched aliphatic hydrocarbon group with a carbon number of 3-17);

(d) 0.1-30 wt% of a glycol; and

(e) 0.5-50 wt% of a builder.

2. The aqueous liquid detergent according to Claim 1, wherein the low-foaming nonionic surfactant is a polyoxyethylene-polyoxypropylene block polymer represented by general formula (II) or (III) below:

$$HO\text{-}(PO)_x\text{-}(EO)_y\text{-}(PO)_z\text{-}H \qquad (II)$$

$$HO\text{-}(EO)_a\text{-}(PO)_b\text{-}(EO)_c\text{-}H \qquad (III)$$

(in formulas (II) and (III), EO denotes an oxyethylene group; PO denotes an oxypropylene group; x, z and b denote average propylene oxide molar addition numbers and are numbers such that $x + z \leq 60$ and $b \leq 60$; y, a and c denote average ethylene oxide molar addition numbers, and are numbers such that $y \leq 150$ and $a + c \leq 150$; and each of x, y, z, a, b and c denotes a number that is greater than 0).

3. The aqueous liquid detergent according to Claim 1, wherein the low-foaming nonionic surfactant is a polyoxyethylene dialkyl ether represented by general formula (IV) below:

$$R^1\text{-}O(EO)_n\text{-}R^2 \qquad (IV)$$

(in formula (IV), $R^1$ denotes a linear or branched alkyl group with a carbon number of 1-24; EO denotes an oxyethylene group; n is the ethylene oxide average molar addition number and denotes a number of 8-30; and $R^2$ denotes a linear or branched alkyl group with a carbon number of 1-18).

4. The aqueous liquid detergent according to Claim 1, wherein the low-foaming nonionic surfactant is a polyoxyalkylene (di)alkyl ether represented by general formula (V) below:

$$R^3\text{-}O\text{-}(EO)_x\text{-}(PO)_y\text{-}(EO)_z\text{-}R^4 \qquad (V)$$

(in formula (V), $R^3$ and $R^4$ may be the same or different, and denote linear or branched alkyl groups with carbon numbers of 1-24 or cycloalkyl groups with carbon numbers of 3-12 (also including a hydrogen atom for $R^4$); EO denotes an oxyethylene group; PO denotes an oxypropylene group; x and z denote average ethylene oxide molar addition numbers and each is a number of 1 or greater; y denotes the average propylene oxide molar addition number and is a number of 1-4; and $(EO)_x$, $(PO)_y$ and $(EO)_z$ are blocked in this sequence).

5. The aqueous liquid detergent according to Claim 1, wherein the low-foaming nonionic surfactant is a polyoxyalkylene (di)alkyl ether represented by general formula (VI) or (VII) below:

$$R^5\text{-}O\text{-}(EO)_x\text{-}(PO)_y\text{-}R^6 \quad (VI)$$

$$R^5\text{-}O\text{-}(EO)_x\text{-}(BO)_z\text{-}R^6 \quad (VII)$$

(in formulas (VI) and (VII), $R^5$ and $R^6$ are the same or different, and denote linear or branched alkyl groups with carbon numbers of 1-24 or cycloalkyl groups with carbon numbers of 3-12 (also including a hydrogen atom for $R^6$); EO denotes an oxyethylene group; PO denotes an oxypropylene group; BO denotes an oxybutylene group; and x, y and z denote average ethylene oxide, propylene oxide and butylene oxide molar addition numbers, and each is a number of 1-20).

6. The aqueous liquid detergent according to any of Claims 1-5 which is used for automatic washing machines.

Detailed explanation of the Invention

[0001]

Technological field of the invention

The present invention relates to an aqueous liquid detergent that is suitable for automatic washing machines.

[0002]

Prior art and problems to be solved by the invention

Detergents are used on a wide variety of products, including food utensils, cups, cans, bottles, plastic containers, shopping baskets, vehicles and floors. With products such as food containers, utensils, beverage bottles and cans, however, food-derived stains such as oils, proteins, starches and the like are often adhered to the products.

[0003]

For this reason, alkali agents have been blended in order to bring about solubilization, cleaning and elimination of stains by means of their hydrolyzing action. In order to additionally increase the oil cleaning power, surfactants have also been used in conjunction, specifically nonionic surfactants. With spray detergents employed by automatic washing machines, bubbles will overflow if the surfactant foams too much, which will decrease the discharge pressure of the sprayer. Low-foaming properties are thus desired.

[0004]

On the other hand, with aqueous liquid detergents in which an alkali agent and a nonionic surfactant are used in conjunction, clouding or separation occurs. Solubilizers are thus used in conjunction due to the poor stability. Japanese Kokai Patent Application No. Sho 64[1989]-4226, for example, discloses the use of specific carboxylic acids as solubilizers along with strong alkali agents and nonionic surfactants.

[0005]

However, when the content of inorganic material as well as alkali agent and nonionic surfactant are increased, the detergent precipitates under high-temperature cleaning conditions in automatic washing machines, even when solubilizer or the like is used. Consequently, sedimentation and separation occur, which decreases the cleaning power.

[0006]

The objective of the present invention is to provide an aqueous liquid detergent that has good cleaning power and stable low-foaming properties, while also resisting clouding, separation and the like.

[0007]

Means for solving the problems

The present invention provides an aqueous liquid detergent that comprises:

(a) 0.5-50 wt% of an alkali agent;

(b) 0.1-25 wt% of a low-foaming nonionic surfactant;

(c) 0.1-30 wt% (fatty acid amount) of a fatty acid represented by general formula (I) or a salt thereof:

$$R\text{-}COOH \qquad (I)$$

(in the formula, R denotes a linear aliphatic hydrocarbon group with a carbon number of 3-13 or a branched aliphatic hydrocarbon group with a carbon number of 3-17);

(d) 0.1-30 wt% of a glycol; and

(e) 0.5-50 wt% of a builder.

[0008]

Embodiments of the invention

Examples of the alkali agent (a) include monoethanolamine, diethanolamine, triethanolamine and other amines; sodium hydroxide, potassium hydroxide and other alkali metal hydroxides; sodium carbonate, potassium carbonate and other alkali metal carbonates; and

sodium silicate, potassium silicate and other alkali metal silicates. The (a) component is blended in the amount of 0.5-50 wt% ("%" below) in the detergent, with 4-30% being preferred, and 5-25% being additionally desirable from the standpoint of cleaning performance and stability.

[0009]

The low-foaming nonionic surfactant (b) in the present invention exhibits sufficient water solubility and water dispersibility, and refers to a compound that does not generate excessive foam, even when used in washing machines. Specifically, one or more compounds selected from those of general formulas (II)-(VII) are preferred.

$$HO\text{-}(PO)_x\text{-}(EO)_y\text{-}(PO)_z\text{-}H \qquad (II)$$

$$HO\text{-}(EO)_a\text{-}(PO)_b\text{-}(EO)_c\text{-}H \qquad (III)$$

(In formulas (II) and (III), EO denotes an oxyethylene group; PO denotes an oxypropylene group; x, z and b denote average propylene oxide molar addition numbers and are numbers such that $x + z \leq 60$, preferably 10-50, and $b \leq 60$, preferably 10-50; y, a and c denote average ethylene oxide molar addition numbers and are numbers such that $y \leq 150$, preferably 2-50, and $a + c \leq 150$, preferably 2-50; and each of x, y, z, a, b and c denotes a number that is greater than 0.)

$$R^1\text{-}O(EO)_n\text{-}R^2 \qquad (IV)$$

(In formula (IV), $R^1$ denotes a linear or branched alkyl group with a carbon number of 1-24; EO denotes an oxyethylene group; n is the ethylene oxide average molar addition number and denotes a number of 8-30; and $R^2$ denotes a linear or branched alkyl group with a carbon number of 1-18.)

$$R^3\text{-}O\text{-}(EO)_x\text{-}(PO)_y\text{-}(EO)_z\text{-}R^4 \qquad (V)$$

(In formula (V), $R^3$ and $R^4$ may be the same or different, and denote linear or branched alkyl groups with carbon numbers of 1-24 or cycloalkyl groups with carbon numbers of 3-12 (also including a hydrogen atom for $R^4$); EO denotes an oxyethylene group; PO denotes an oxypropylene group; x and z denote average ethylene oxide molar addition numbers, and each is a number of 1 or greater, preferably 2-10; y denotes an average propylene oxide molar addition number and is a number of 1-4; and $(EO)_x$, $(PO)_y$ and $(EO)_z$ are blocked in this sequence.)

$$R^5\text{-}O\text{-}(EO)_x\text{-}(PO)_y\text{-}R^6 \quad (VI)$$

$$R^5\text{-}O\text{-}(EO)_x\text{-}(BO)_z\text{-}R^6 \quad (VII)$$

(In formulas (VI) and (VII), $R^5$ and $R^6$ are the same or different, and denote linear or branched alkyl groups with carbon numbers of 1-24 or cycloalkyl groups with carbon numbers of 3-12 (also including a hydrogen atom for $R^6$); EO denotes an oxyethylene group; PO denotes an oxypropylene group; BO denotes an oxybutylene group; and x, y and z denote average ethylene

oxide, propylene oxide and butylene oxide molar addition numbers, where each is a number of 1-20.)

[0010]

The (b) component is blended in the amount of 0.1-25%, preferably 0.5-5%, and more preferably 0.5-2%, from the standpoint of oil cleaning power and solution stability.

[0011]

Examples of aliphatic acids or salts thereof (c) represented by general formula (I) pertaining to the present invention that may be cited include n-butyric acid, valeric acid, sorbic acid, caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, undecanoic acid and other linear fatty acids and salts thereof, as well as isobutyric acid, 2-ethylhexanoic acid, isopalmitic acid, isostearic acid and other branched fatty acids and salts thereof. The (c) component is blended in the detergent in an amount of 0.1-30% based on the amount of fatty acid, with 0.5-10% being preferred, and 1-5% being additionally desirable from the standpoint of obtaining the desired solution stability. The (c) component is normally present in the detergent as a salt resulting from neutralization by the (a) component.

[0012]

Examples of glycols (d) include ethylene glycol, diethylene glycol, triethylene glycol, polyethylene glycol (Mw = 200-12,000), propylene glycol, dipropylene glycol, tripropylene glycol, polypropylene glycol (Mw = 600-4000), 1,3-butanediol, 1,4-butanediol, polytetramethylene ether glycol (Mw = 650-1000), 1,5-pentanediol, 2-methyl-2,4-pentanediol, 3-methyl-1,5-pentanediol, 1,6-hexanediol and 2-ethyl-1,3-hexanediol. Propylene glycol and 1,4-butanediol are particularly desirable. The (d) component is blended at 0.1-30% in the detergent, with 0.5-10% being preferred, and 1-5% being additionally desirable from the standpoint of obtaining the desired stability.

[0013]

The builder (e) refers to a compound that eliminates alkali agent (a), and specific examples include ethylenediaminetetraacetic acid (EDTA), hydroxyethylethylenediaminetriacetic acid, diethylenetriaminepentaacetic acid, nitrilotriacetic acid, triethylenetetraaminehexaacetic acid, ethylene glycol bis(2-aminoethyl ether)tetraacetic acid, citric acid, maleic acid, silicic acid, gluconic acid, fumaric acid, hydroxybenzyliminodiacetic acid, iminodiacetic acid, phosphoric acid, polyphosphoric acid, phosphonic acid and salts thereof. Additional examples include polyacrylic acid, polyacetic acid,

acrylic acid-maleic acid copolymer, isoamylene-maleic acid copolymer and other oligomers or polymers (weight-average molecular weight 1000 to a few tens of thousands), some of which may be converted into salts. These macromolecular builders have superior dispersion capacity with respect to scale components and the like. Salts that may be cited are sodium salts, potassium salts, ammonium salts and alkanolamine salts. The (e) component is blended in the detergent in an amount of 0.5-50%, with 1-30% being preferred, and 5-10% being additionally desirable from the standpoint of obtaining the desired cleaning power and solution stability.

[0014]

Other additives such as bleaches, antimicrobial agents, preservatives, antirust agents, organic solvents, thickeners, fragrances, colorants and acids may be blended as necessary in the aqueous liquid detergent of the present invention in suitable ranges that do not impede the effects of the present invention.

[0015]

The aqueous liquid detergent of the present invention generally is produced by blending and stirring when each component is a liquid, but when solid materials are included, liquid components are generally added after first dissolving compounds in water, followed by mixing and stirring. There are no particular restrictions on the addition or dissolution sequence, since these sequences will depend on the composition.

[0016]

The aqueous liquid detergent of the present invention has a pH of 10 or above as a 1 wt% aqueous solution (25°C), and a pH of 11-13.5 is particularly desirable.

[0017]

Application examples

Application Examples 1-6, Comparative Examples 1-3

Aqueous liquid detergents presented in Table 1 were prepared. A detergent feeder was installed in an automatic utensil washer DW-230L manufactured by Sanyo Electric, and detergent was supplied from this feeder while a cleaning test was carried out under the conditions indicated below. The cleaning properties and low-foaming properties were evaluated by the standards indicated below. The storage stability was also evaluated.

[0018]

(I) Cleaning properties

Cleaning conditions

Cleaning temperature: 60 ± 2°C

Cleaning time: 45 sec

Detergent concentration: 0.15%

Cleaning time: 15 sec

Cleaning temperature: 80 ± 2°C

Material to be cleaned

Material to be cleaned 1: Simulated composite stain (protein, oil, starch mixture) was applied at 5 g per porcelain dish and was dried, producing four dishes (200 mm diameter x 30 mm height).

Material to be cleaned 2: Salad oil was applied at 5 g per polypropylene dish, producing four dishes (200 mm diameter x 30 mm height).

Evaluation standards

⊚: Stain completely removed

O: Stain mostly removed

Δ: Insufficient stain removal

X: Almost no stain removal

[0019]

(II) Low-foaming properties

30 mL of 1% detergent aqueous solution was introduced into a test tube (length 25 mm, inner diameter 30 mm), and after adjusting the solution temperature to 40°C, the solution was shaken 20 times, and the foam height was measured after 10 sec.

Evaluation standards

⊚: Low foam amount (foam height less than 10 mm)

O: Average foam amount (foam height 10 mm or greater, less than 20 mm)

Δ: Fairly large foam amount (foam height 20 mm or greater, less than 50 mm)

X: Large foam amount (foam height 50 mm or greater)

[0020]

(III) Stability

The detergent was stored for 30 days at 40°C or for 30 days at -5°C, and its stability was evaluated.

Evaluation standards

O: Transparent (no clouding or separation)

Δ: Slightly cloudy

X: Separation

[0021]

Table 1

| ① 配合成分(重量%) | | ② 実施例 | | | | | | ③ 比較例 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| (a) | KOH | 5 | 5 | 5 | 4 | 15 | 20 | 5 | 5 | 20 |
| | 1号珪酸ソーダ ④ | 5 | 5 | 5 | 5 | | | 5 | 5 | |
| | 炭酸ソーダ | 6 | 6 | 6 | | | | 6 | 6 | |
| | モノエタノールアミン | | | | 10 | | | | 5 | |
| (b) | ノニオン界面活性剤1 | 1 | | | 1 | 1 | 1 | 1 | | |
| | ノニオン界面活性剤2 | | 1 | | | | | | 1 | |
| | ノニオン界面活性剤3 | | | 1 | | | | | | |
| (c) | カプリル酸 | 2 | 2 | 2 | 2 | 5 | 10 | | 2 | 2 |
| (d) | プロピレングリコール | 2 | 2 | 2 | | 2 | 2 | | | |
| | 1,4-ブタンジオール | | | | 2.5 | | | 2.5 | | 2.5 |
| (e) | EDTA-4Na | 10 | 10 | 10 | 5 | 10 | 10 | 5 | 5 | 5 |
| | グルコン酸Na | | | | 3 | | | | | |
| | トリポリリン酸カリウム | | | | 10 | | | | | 10 |
| | ポリアクリル酸ナトリウム(Mw4000) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ⑤ 水 | | 残部 | 残部 | 残部 | 残部 | 残部 | 残部 | 残部 | 残部 | 残部 |
| ⑥ 1%水溶液のpH | | 12 | 12 | 12 | 12.5 | 12.5 | 13 | 12 | 12 | 13 |
| 洗浄性 ⑦ | 被洗物1 ⑧ | ○ | ○ | ○ | ◎ | ◎ | ◎ | ○ | ○ | ○ |
| | 被洗物2 ⑨ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ○ | ○ | × |
| 低泡性 ⑩ | | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | △ |
| 安定性 ⑪ | 配合時 ⑫ | ○ | ○ | ○ | ○ | ○ | ○ | × | ○ | ○ |
| | 40℃×30日 ⑬ | ○ | ○ | ○ | ○ | ○ | ○ | × | × | ○ |
| | -5℃×30日 ⑭ | ○ | ○ | ○ | ○ | ○ | ○ | × | × | ○ |

⑮

Key
1 Blended component (wt%)
2 Application example
3 Comparative example
4 No. 1 sodium silicate

Sodium carbonate
Monoethanolamine
Nonionic surfactant 1
Nonionic surfactant 2
Nonionic surfactant 3
Caprylic acid
Propylene glycol
1,4-butanediol
EDTA-4Na
Sodium glycolate
Potassium tripolyphosphate
Sodium polyacrylate (Mw 4000)
Water
pH of 1% aqueous solution
Cleaning power
Material to be cleaned 1
Material to be cleaned 2
Low-foaming properties
Stability
At the time of blending
40°C x 30 days
-5°C x 30 days
Remainder

[0022]

Nonionic surfactant 1: Compound wherein x = 21, y = 14 and z = 22 in general formula (II).

Nonionic surfactant 2: Compound wherein $R^1 = C_{12}$, n = 12 and $R^2 = C_8$ in General Formula (IV).

Nonionic surfactant 3: Compound wherein $R^3 = C_{12}$, x = 7, y = 1.5, z = 7 and $R^4 = C_8$ in general formula (V).

Sodium polyacrylate (Mw = 4000)

Caprylic acid: Lunac 8-98, Kao Corp.; blend amount based on fatty acid.

[0023]

Effect of the invention

The aqueous liquid detergent of the present invention has superior cleaning power, low-foaming properties and storage stability, and thus is suitable for use as an aqueous liquid detergent for automatic washers which must provide effective cleaning in a short period of time.